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THE UNITED STATES OF AMERICA

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UNITED STATES DEPARTMENT OF COMMERCE

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January 18, 2005

THIS IS TO CERTIFY THAT ANNEXED HERETO IS A TRUE COPY FROM THE RECORDS OF THE UNITED STATES PATENT AND TRADEMARK OFFICE OF THOSE PAPERS OF THE BELOW IDENTIFIED PATENT APPLICATION THAT MET THE REQUIREMENTS TO BE GRANTED A FILING DATE UNDER 35 USC 111.

APPLICATION NUMBER: *60/534,315*

FILING DATE: *January 05, 2004*

PRIORITY DOCUMENT

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By Authority of the

COMMISSIONER OF PATENTS AND TRADEMARKS

P. R. Grant

P. R. GRANT

Certifying Officer

PROVISIONAL APPLICATION COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION under 37 CFR 1.53(b)(2).

Docket Number		Type a plus sign (+) inside this box ☐	+
704113			

INVENTOR(s)/APPLICANT(s)

LAST NAME	FIRST NAME	MIDDLE INITIAL	RESIDENCE (CITY AND EITHER STATE OR FOREIGN COUNTRY)
GUTTA	SRINIVAS		EINDHOVEN, THE NETHERLANDS

TITLE OF THE INVENTION (280 characters max)

AUTOMATIC SETTING OF 'LIVING LIGHTS' DEPENDING ON THE COLOR INFORMATION INHERENT IN CONTENT

CORRESPONDENCE ADDRESS

Corporate Patent Counsel
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STATE	New York	ZIP CODE	10591	COUNTRY	U.S.A.

ENCLOSED APPLICATION PARTS (check all that apply)

X	Specification	Number of Pages	7	☐	Small Entity Statement
☐	Drawing(s)	Number of Sheets	0	☐	Other (specify)

METHOD OF PAYMENT (check one)

		PROVISIONAL FILING FEE AMOUNT ($)	$160.00
☐	A check or money order is enclosed to cover the Provisional filing fees		
X	The Commissioner is hereby authorized to charge filing fees and credit Deposit Account Number: 14-1270		

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The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

[X] No

[ ] Yes, the name of the U.S. Government agency and the Government contract number are:

Respectfully submitted,

SIGNATURE: Michael E Belk Date: 1/5/04

TYPED or PRINTED NAME: MICHAEL E. BELK

REGISTRATION NO.: 33,357

[ ] Additional inventors are being named on separately numbered sheets attached hereto

CERTIFICATE OF EXPRESS MAILING

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Date of Deposit January 5, 2004

I hereby certify that this paper and/or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 C.F.R. 1.10 on the date indicated above and is addressed to the Commissioner for Patent, Alexandria, VA 22313.

Noemi Chapa Noemi Chapa
Typed Name Signature

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Automatic setting of 'Living Lights' depending on the color information inherent in the content

This invention is primarily concerned with the setting of ambient light - center lights around a TV based on the content that is being currently watched by the user. Basically average color information is extracted from the borders of the content and mapped onto the LED space. Next, the mapped color information is used to set the LED units around the TV thereby creating light effects synchronous to the watched content.

The general steps that need to be followed to realize the invention are as follows:

1) Acquire a video signal and decode the video signal into a set of frames
2) Extract color information from the content (frames) around the boundary
3) Transform the color information of the content from the RGB space onto the color space of the LEDs and the displays color space.
4) Transmit the transformed color information of the content to the LED units so as to trigger them.

Steps (1) and (4) are straightforward and are not further discussed below.

The current setup for an ambient lighting system is as shown below:

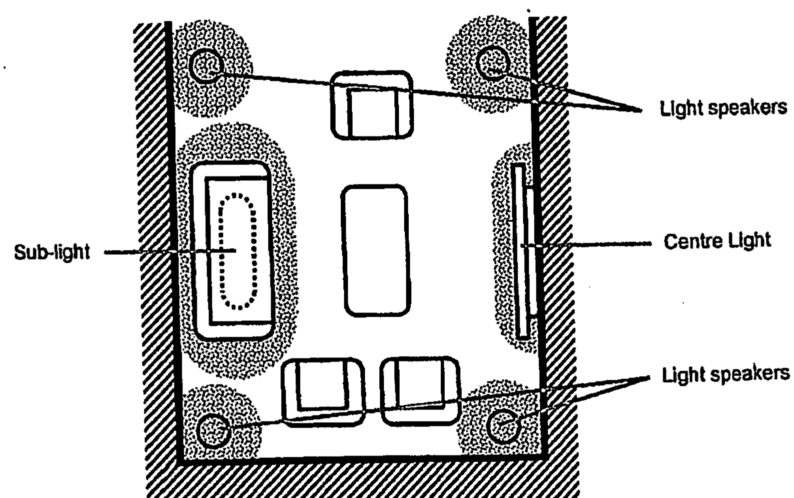


Figure 1. Setup of Light Units

In the above figure there are 11 independently controllable LED lighting units. There are four light speakers, one unit under the couch ('Sub-light') and 6 LED units on the center-light. The center-light is a little bit special, in the way it is set-up - it has 6 independently controlled, light units behind the four sides of the Flat TV and is shown below:

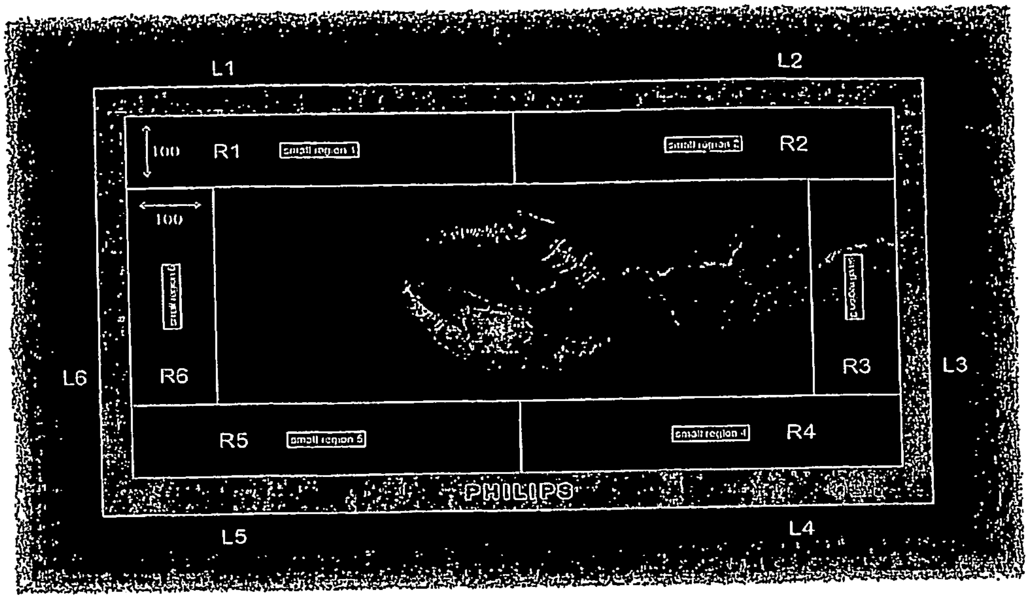


Figure 2: Setup of light units around the TV

In the above figure L1 to L6 refer to the light units around TV. The figure also shows a single frame of the content displayed on the TV. Each light unit located at back of the TV is triggered by extracting the average color information from each region – R1 to R6. Each region has a width of 100 pixels. As an example if the size of the frame were 720x576 pixels, then the size of R1, R2, R4 and R5 would be 360x100 pixels. Similarly size of R3 and R6 would be 100x376 pixels.

Since the video signal is decoded into a set of frames (25 frames per second) in the RGB color space, the resulting image size would be 720x576x3 which is a 3D matrix where each 2D matrix of size 720x576 corresponds to each one of the Red, Green and Blue channels.

The average color information for each region of the channel is extracted by summing up all the pixels in that region and dividing by the total number of pixels in that region for each channel. The equation for the extraction of the average color information for each region for one channel is shown below:

$$R_{red} = \frac{\sum_{i=1,j=1}^{n,m} M_{ij}}{n \times m}$$

If the region under consideration is R1, then M_{ij} is of size 360x100 with n equal to 360 and m equal to 100. The above equation gives us the average of all the pixels for the red channel. Thus the average color for particular region would now be a triplet,

$$R_{AVE} = \lfloor R_{red}, R_{green}, R_{blue} \rfloor$$

The same procedure is repeated for all the regions and for all the channels within each region.

Next in order to set the lights, a mapping transformation needs to be performed between the TV and light units. This is achieved via a standard set of equations that take as input the measured color primaries from each LED unit. The color primaries for the red, green, blue and the reference white color components are acquired by using a color spectrometer. Once the primaries are obtained, the transformation process is as follows:

(a) Given a set of chromaticity (red, green and blue primaries) co-ordinates and the reference white, compute the transformation matrix for mapping the average color information onto the XYZ color gamut space for both the FLAT TV as well as the LED units. This gives us two set of equations :

$[X; Y; Z]=M_1 * [R;G;B]$ for Flat TV

$[X; Y; Z]=M_2 * [R';G'B']$ for LED's

(b) The mapped RGB values for the light units could be found by solving the following:

$$[R';G';B'] = M_2^{-1} * M_1 * [R;G;B]$$

In steps (a) above, [R; G; B] corresponds to the triplet which is nothing but the computed average color information for a particular region for all channels. The general method for computing the matrix M is shown below:

Given the chromaticity coordinates of an RGB system (x_r,y_r), (x_g,y_g) and (x_b,y_b) and the white point (x_w,y_w), the method to compute the 3 x 3 matrix for converting RGB to XYZ is as follows:

$$[X\,Y\,Z] = [R\;G\;B][M]$$

where

$$[M] = \begin{pmatrix} S_rX_r & S_rY_r & S_rZ_r \\ S_gX_g & S_gY_g & S_gZ_g \\ S_bX_b & S_bY_b & S_bZ_{gb} \end{pmatrix}$$

$$X_r = x_r \qquad Y_r = y_r \qquad Z_r = 1-(x_r+y_r)$$

$$X_g = x_g \qquad Y_g = y_g \qquad Z_g = 1-(x_g+y_g)$$

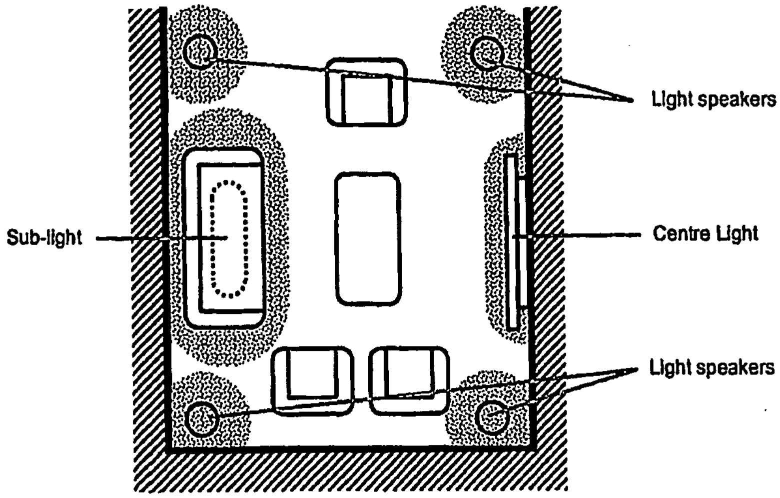
$$X_b = x_b \qquad Y_b = y_b \qquad Z_b = 1-(x_b+y_b)$$

$$X_w = x_w \qquad Y_w = y_w \qquad Z_w = 1-(x_w+y_w)$$

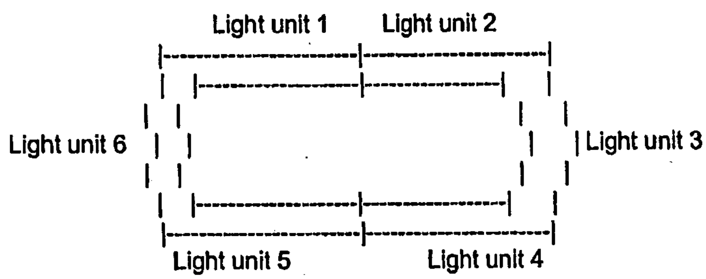
$$[S_r \quad S_g \quad S_b] = [X_w \quad Y_w \quad Z_w] \begin{pmatrix} X_r & Y_r & Z_r \\ X_g & Y_g & Z_g \\ X_b & Y_b & Z_b \end{pmatrix}^{-1}$$

The above method is used for obtaining M_1 and M_2 and [R';G';B'] by following step (b) above. Thus [R';G';B'] is the transformed color information for a particular region. The same process is repeated for obtaining [R';G';B'] for each of the 6 regions. The transformed color information is then sent to the light units so that they could be triggered. Please note that the whole process is repeated for all the frames (25) in each second. It is also important to note that the width of each region could be varied and the number of regions in the frame could also be varied. As an example, instead of using 6 regions, one could use only 4 regions as well. In such a case, the transformed color information for the upper region could be sent to both the LED panels located at the top of the TV. Furthermore, the solution discussed above could be realized in software or via a programmable hardware platform such as EPLD, etc.

INVENTION DISCLOSURE (continued)



the above figure there are 11 independently controllable LED lighting units. There are four light speakers, one unit under э couch ('Sub-light') and 6 units on the centre-light. The centre-light is a little bit special, in the way it is set-up.

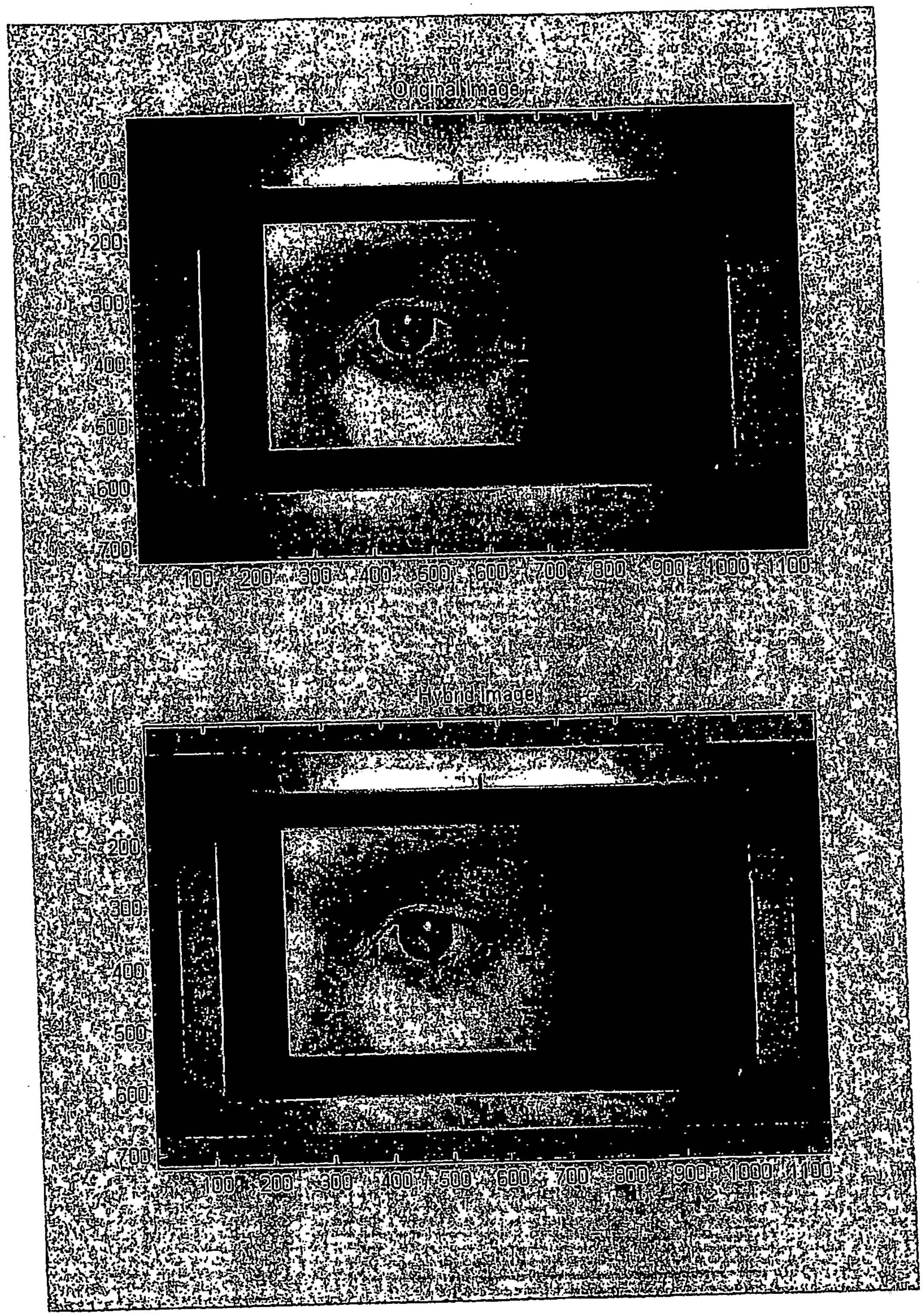


has 6 independently controlled, light units at the four sides of the Flat TV. All the 11 units take one RGB coordinate from e corresponding color space.

ıe following general steps are followed so that the appropriate light speakers are set depending upon the content that is ırrently being watched:

(a) Acquire the video signal and the tuning information from the TV
(b) Extract color information from the content (frames) that is currently being played
(c) Map the color information onto the LED speakers RGB space
(d) Transmit the RGB coordinates to the light speakers so as to turn them on with the required light setting

steps, (a) and (b) are straightforward, they are not described below. Regarding step (b), each frame of the video in estion is split up into individual frames. For each frame, 6 non-overlapping borders are defined, each with a width of proximately 50 pixels. From each such border, we average all the pixels to get an average color for that border. One ample of an image where the color extraction is performed is shown below:



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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of

SRINIVAS GUTTA

Serial No.

Filed: CONCURRENTLY

Atty. Docket

704113

Group Art Unit:

Examiner:

Title: AUTOMATIC SETTING OF LIVING LIGHTS DEPENDING ON THE COLOR INFORMATION INHERENT IN CONTENT

Commissioner for Patents
Alexandria, VA 22313

APPOINTMENT OF ASSOCIATES

Sir:

The undersigned Attorney of Record hereby revokes all prior appointments (if any) of Associate Attorney(s) or Agent(s) in the above-captioned case and appoints:

MICHAEL E. BELK **(Registration No. 33,357)**
c/o U.S. PHILIPS CORPORATION, Intellectual Property Department, 580 White Plains Road, Tarrytown, New York 10591, his Associate Attorney(s)/Agent(s) with all the usual powers to prosecute the above-identified application and any division or continuation thereof, to make alterations and amendments therein, and to transact all business in the Patent and Trademark Office connected therewith.

ALL CORRESPONDENCE CONCERNING THIS APPLICATION AND THE LETTERS PATENT WHEN GRANTED SHOULD BE ADDRESSED TO THE UNDERSIGNED ATTORNEY OF RECORD.

Respectfully,

Michael E. Marion, Reg. 32,266
Attorney of Record

Dated at Tarrytown, New York
this 5th day of January, 2004.

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APPLICATION NUMBER: *60/534,266*
FILING DATE: *January 05, 2004*

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